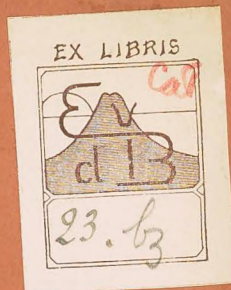


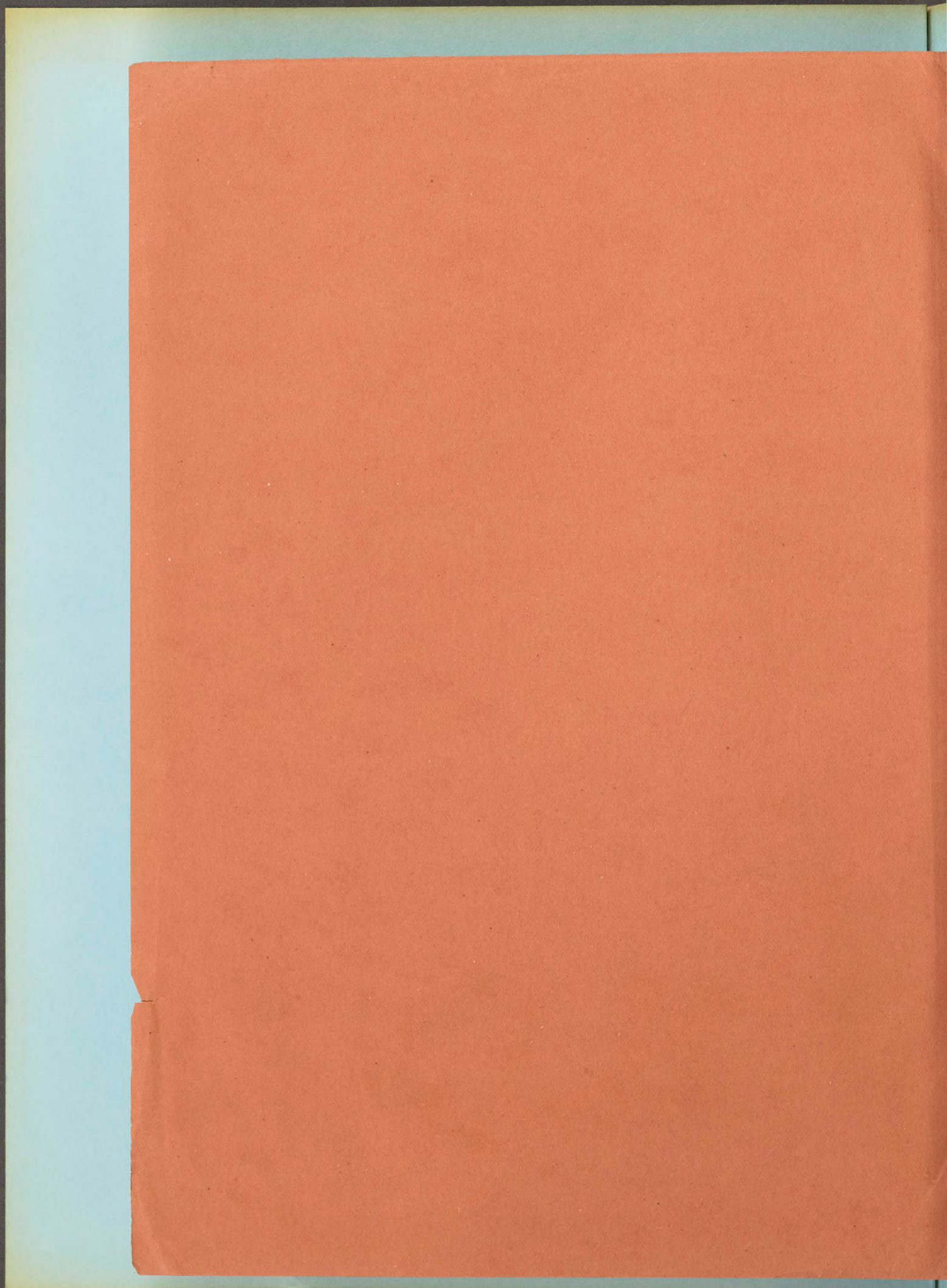
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NOTE ON THE TOURMALINE (SCHORL) MINES IN
THE MAINGLÔN STATE.

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[FROM THE RECORDS, GEOLOGICAL SURVEY OF INDIA, VOL. XXIV, PT. 2, 1891.]

Note on the Tourmaline (Schorl) Mines in the Mainglôn State; by FRITZ NOETLING, PH.D., *Palæontologist, Geological Survey of India.*

1. *Situation of the mines.*—The mines are situated in the broad valley which extends north of the town of Mainglôn, from north-east to south-west for a distance of about 5 miles with a maximum breadth of nearly 2 miles. The geographical position may be Long. $96^{\circ} 44'$, Lat. $22^{\circ} 46'$. The valley is traversed by the Nampai, which, coming from the hills to the north-east, slowly makes its way through the broad plain until it disappears again as a wild torrent in the narrow gorge which forms the western outlet of the valley. The mines are situated on both sides of the Nampai along the slopes. The principal mines are near the villages of Naungdaw and Naungheng, about 2 to 3 miles to the north of the town of Mainglôn. No mines are near this place itself.

2. *Geology: (a) Gneissic and submetamorphic formations.*—As regards the azoic formations they are the same as those observed in the neighbourhood of Namsêka, and everything that I have said about these formations in my report on the Namsêka ruby-mines also applies to them as far as the country around Mainglôn is concerned. The gneiss is particularly developed north and north-east of the Nampai, while the submetamorphic shales are found in the south and the west. Mainglôn itself is situated on a low hill projecting to the north, which is formed by green shales, dipping towards the west, covered by a thick layer of river conglomerate of about 50 feet in thickness.

(b) *Alluvial deposits.*—Amongst the alluvial deposits found in the Nampai valley we can distinguish two groups: (i) an older one consisting of conglomerates and red clay, and (ii) a younger one consisting chiefly of black tough paddy-soil. While the first group is found up to heights of about 200 feet above the present level of the river, the second one is strictly limited to the low plains.

(b) (i) *The older river deposits. I. Conglomerates.*—The conglomerates which form, so far as is known at present, the basis of the older alluvial deposits consist chiefly of well-rounded smooth pebbles of quartz-rock in various sizes, from small grains up to the size of a man's head and over. Other rocks are scarce, and only occasionally a small pebble of blue silicious shale, or rotten schistose sandstone is found; not uncommon are well-rounded pebbles of black tourmaline (schorl) reaching the size of a walnut. These have sometimes their original crystal shape preserved still, but they always show that they were much water-worn; much scarcer evidently is the red tourmaline, as I did not succeed either in discovering a specimen *in situ* or in obtaining samples of it from the natives. The only sample I have seen I received through Lieutenant Daly; it was a small fragment of a crystal of pale pink colour stained with flaws and much rolled. The natives stated that occasionally big specimens are found which are sold at a high price, but they are very scarce. They even say that small specimens of hardly any value are not common. Besides the minerals mentioned, I found a fragment of rock crystal and a piece of agate. The monotonous composition of this conglomerate proves clearly enough that it is made up from the débris of a country where there was only a small variety of strata; very likely the strata consisted chiefly of gneissic and granitic rocks. The pebbles are cemented by a coarse gritty clay of yellowish colour, thus forming a compact hard mass, which is hardly affected by ordinary tools, as the pickaxe rebounds on the smooth rounded quartz-rock pebbles.

It is very likely that the conglomerate, like all other strata of similar composition, contains a small quantity of gold which was extracted by the miners. I do not say that gold-washing operations were their chief object, but I feel strongly inclined to think that they gave the original start and that in the progress of the work the tourmalines were discovered and the exploitation of these stones, highly valuable in the eyes of Chinamen, was gradually substituted for that of gold, although the latter was never quite neglected. I did not, however, succeed in getting information on this point, as the natives were very suspicious lest anything should be known.

II. *The red clay.*—The conglomerates are everywhere covered by a layer of tough red clay, not particularly gritty, but containing numerous angular grains of quartz-rock and felspar. The clay does not show any sign of bedding, and forms one continuous layer from the floor to the top. Its thickness varies much, as at some places it certainly exceeds 50 feet, while at others it is between 15 and 20 feet. It is most remarkable that clay and conglomerate never alternate, but that they are separated by a sharp limit, the clay being always on the top of the conglomerate, which it conceals perfectly. The soft, rounded features of the low hills round Mainglôn are due to this superficial coat of red clay.

(b) (ii) *The younger river deposits.*—There is not much to be said from a geological point of view about these deposits, although they certainly form a most valuable tract from an agricultural point of view. There is the well-known dark grey or black soil, a tough clay mixed with a high percentage of decomposed organic

matter, which would afford excellent paddy ground if irrigated. The younger river deposits are strictly limited to the lowlands in the Mainglôn valley.

3. *Extension and origin of the older alluvial deposits.*—In a continuous layer the older alluvial deposits are especially found along the slopes of the hills which border the Mainglôn valley. They, however, also form isolated hills or short ranges in the centre of the valley, thus proving that they originally filled the whole valley, but became afterwards divided, probably by the action of the Nampai, which cut its bed through these deposits, only leaving them along slopes of the hills, and here and there in isolated patches in the centre of the basin. Along the slope of the hills they form a very distinct escarpment level at its surface, being in accord with that of the hills in the centre of the valley. The deposit of two strata requiring conditions so absolutely different in one and the same locality, and evidently immediately succeeding one another, forms, however, a problem which cannot easily be solved. The compact mass of the conglomerate must have been deposited under the influence of a very strong current, while the clay must naturally have been deposited in still water. That conglomerate and clay cannot have been deposited in or by one and the same water is proved by the sharp separation. If they were deposited gradually, there must certainly be found some kind of intermediate bed, from coarse gravel gradually leading to fine sand and clay, but nothing of this kind is observed, and the clay rests immediately on the top of the biggest pebbles. I believe that the Mainglôn valley formed a kind of lake on the bottom of which the Nampai deposited the bulk and particularly the heavier parts of the *débris*, thus forming the conglomerate, while the silt and finer material were carried away. Gradually the basin of the lake became more and more filled up, and consequently the level of the water rose. Now, there must have been a day when the bar which closed the western outlet of the lake gave way, and the water digging its way through its own deposits and carrying large quantities of them away, thus formed the channel through which now the Nampai runs, and through which the heavier material was transported in the future. Occasional high floods may have sometimes restored the old lake when the outlet was still narrow and was blocked, but the heavier material was no longer stored up, and the current was always strong enough to carry it away through the channels which formed in the dry season the river bed. Along the borders of the lake and wherever there was quiet water the finer material was deposited on the top of the older conglomerate, thus forming the younger clay.

I did not find any organic remains in either conglomerates or clay. That none could be preserved in the conglomerate is intelligible, but it is rather strange that no shells should have been preserved in the clay. However, they may be discovered hereafter.

4. *Description of the mines.*—The pits, now deserted, from which the tourmaline were dug are numerous, and those which have apparently been worked quite recently may be seen anywhere along the slopes of the valley. The place for making a pit was always chosen with a view to getting an easy and ample supply of water for washing purposes, and was so situated that the finer *débris* and used water could easily be got rid of. The pits are therefore all at a certain height above the present river level, while the water is brought down from higher places in channels of considerable length. It is therefore easily understood that for these two reasons the workmen can only exploit the conglomerate at a certain limited height. If the pits are too high up on the slope, it is rather difficult to get a sufficient supply of

water; if too low down, the water will not easily flow off. The style of work is simple enough. At first the covering clay is removed till the surface of the conglomerate is exposed. As a rule, a large piece of conglomerate is freed at once. In the pit the surface of the conglomerate measured about 250 by 105 feet. As the thickness of the clay averaged about 10 feet, the quantity of clay to be removed before the operations could be started was very considerable.

The water, in a channel coming from the south-east, was conducted in the back ground of the pit along the perpendicular wall of clay, to the place where it was wanted for working purposes. It was then made to run on the surface of the conglomerate and to trickle down in part of the working place, thus softening the clayey cement, so that the pebbles could afterwards be easily removed. The miner, by heaping the larger pebbles on the free room behind himself, while searching the conglomerate in front, gradually turned over the whole of the conglomerate without being obliged to carry away the large and heavy pebbles. The smaller débris was washed in baskets, the tourmalines picked out, and the remainder probably re-washed for gold. The conglomerate has been nearly completely worked out at the southern side of the pit. A few rests are still remaining as a support to the water channel. On the northern side there is still a large quantity left, but when this is worked out, either the pit will have to be deserted or the tiresome work of removing a still larger quantity of clay than in the beginning will have to be started again.

It is perfectly clear that this kind of work requires large quantities of water. The mines can therefore only be worked during the rainy season and for a short time after its termination. It is intelligible that the difficulties are therefore such as to make tourmaline mining not only a slow but also a not very profitable business, if the scarcity and the comparatively small value of the mineral be taken into consideration.

5. *Old mines.*—Tourmaline being a mineral which is generally associated with granite, I was of course anxious to trace, if possible, the original locality whence the specimens found in the conglomerate were derived. As all the signs pointed to the north-east as this probable source, I extended my examinations up the banks of a small river called Nyaungdauk, where at a place called Mawtunim, large deserted pits could be seen. It was stated that the Chinese had formerly worked these pits. When I visited this locality I saw a large circular pit of about 300 feet in diameter and from 100 to 150 feet deep on the slope of the hill; the walls and the bottom were, however, covered with dense jungle; on the outer side of the dry pit there were numerous smaller ones, and large heaps of refuse proved too clearly that once extensive mining operations had been going on here. I was, however, unable to find out with certainty the object of these mining operations, although I searched the refuse for a long time. The refuse consisted of pieces of granite, and, although I carefully looked for, I did not find even the slightest trace of a metallic ore. If such had been the object, traces of it would certainly have been found. Amongst the refuse I discovered, however, numerous crystals of black tourmaline (schorl). As the hill was formed of granite, it is very probable that at this place a vein yielding pink tourmaline was exploited, and that the rolled specimens of this mineral must originate somewhere in the neighbourhood of this place. It would, however, require extensive clearings to ascertain the correctness of this opinion, and I should not recommend them, considering the small value of tourmaline. A similar pit of larger size was said to exist about 2 miles higher up the stream.

